IN THE SPECIFICATION :

[0015] It is preferable that the oxidation gas humidifier comprises a pair of separating plates and a humidifying membrane. The separating plates are disposed to face each other such that the coolant exhausted from the fuel cell stack flows therebetween. The humidifying membrane is disposed at a side of the separating plate such that the remaining oxidation gas exhausted from the fuel cell stack flows in one side of the humidifying membrane, and oxidation gas that is supplied to the fuel cell stack from the oxidation gas supply unit flows in the other side of the humidifying membrane. The heat contained in the coolant flowing between the pair of separating plates and heat contained in the remaining oxidation gas are transmitted to the ~~fuel gas~~ oxidation gas supplied to the fuel cell stack, and water contained in the remaining oxidation gas is supplied to the oxidation gas supplied to the fuel cell stack through the humidifying membrane.

[0018] Preferably, the coolant is an anti-freeze solution. It is further preferable that the fuel cell system comprises an auxiliary humidifier unit controlled by the control unit, the auxiliary humidifier unit collecting water contained in the remaining fuel gas passing through the fuel gas humidifier and in the remaining oxidation gas passing through the oxidation gas humidifier. The auxiliary humidifier unit comprises~~, and the~~ an auxiliary humidifier humidifying the fuel gas that is supplied to the fuel cell stack from the fuel gas supply unit and the oxidation gas that is supplied to the fuel cell stack from the oxidation gas supply unit.

[0019] It is preferable that the auxiliary humidifier unit comprises a remaining exhaust condensation unit, a water storage unit, a first injector, and a second injector. The remaining exhaust condensation unit condenses the remaining fuel gas passing through the fuel gas humidifier and the remaining oxidation gas passing through the oxidation gas humidifier. The water storage unit receives and stores water generated by the remaining exhaust condensation unit. The first injector injects water stored in the water storage unit into the fuel gas supplied to the fuel cell stack from the fuel gas supply unit, while the second injector injects water stored in the water storage unit into the oxidation gas supplied to the fuel cell stack from the oxidation gas supply unit.

[0020] Preferably, the auxiliary humidifier unit further comprises an electric heater disposed at the auxiliary humidifier for heating water stored in the water storage unit, and it is

preferable that the electric heater is controlled to operate for a predetermined time if the ambient temperature is lower than a predetermined temperature.

[0038] A portion of the coolant (e.g., 10% of the coolant) passes through a coolant bypass passage ~~line~~ 41 that bypasses the fuel cell stack 13 and the fuel gas and oxidation gas humidifiers 21 and 23, and through a coolant filter 43 that is disposed in the coolant bypass passage ~~line~~ 41. Ethylene can corrode components through which the coolant passes causing impurities to exist in the coolant, and such impurities may cause a malfunction of the fuel cell stack 13. The coolant filter 43 removes such impurities from the coolant.

[0040] As shown in FIGs. 1 and 2, fuel gas is supplied to the fuel cell stack 13 through the fuel gas supply line 27, and remaining fuel gas is exhausted from the fuel cell stack through the remaining fuel gas exhaust line 31 and the fuel gas humidifier 21. The coolant exhausted from the fuel cell stack 13 also passes through the fuel gas humidifier 21.

[0053] The fuel gas recycling unit 61 is disposed in a fuel gas recycling line 63 connecting the remaining fuel gas exhaust line 31 and the fuel gas supply line 27, and it forces a portion of the exhausted fuel gas to the fuel gas supply line 27, so that the fuel gas is supplied to the fuel cell stack 13. As an example, the fuel gas recycling unit 61 can be a compressor.

[0054] The fuel cell system 11 according to the preferred embodiment of the present invention further comprises an auxiliary humidifier unit including an auxiliary humidifier 65 for humidifying the fuel gas and the oxidation gas that are supplied to the fuel cell stack 13. The auxiliary humidifier 65 collects water from the remaining fuel gas that has passed through the fuel gas humidifier 21 ~~27~~ and from the remaining oxidation gas that has passed through the oxidation gas humidifier 23 ~~29~~, and humidifies the oxidation gas and the fuel gas that are supplied to the fuel cell stack 13 using the collected water.

[0055] The auxiliary humidifier unit ~~65~~ further includes an exhaust gas condensing unit 67 for condensing water contained in the remaining fuel gas that has passed through the fuel gas humidifier 21 and in the remaining oxidation gas that has passed through the oxidation gas humidifier 23. It still further includes a first condenser 69 for condensing the remaining fuel gas that has passed through the fuel gas humidifier 21, and a second condenser 71 for

condensing the remaining oxidation gas that has passed through the oxidation gas humidifier 23.

[0056] The first and second condensers 69 and 71 are connected to a radiator 75 through a coolant circulating passage ~~circulation line~~ 73. A coolant pump 77 is disposed in the coolant circulating passage ~~circulation line~~ 73, and the coolant pump 77 pumps coolant such that the coolant circulates through the first and second condensers 69 and 71 and the radiator 75, through the coolant circulating passage ~~circulation line~~ 73.

[0057] While the coolant passes through the first and second condensers 69 and 71, the first and second condensers condense water contained in the remaining fuel gas and the remaining oxidation gas, thereby allowing water to be collected from the remaining exhaust gas. Water collected by the first and second condensers 69 and 71 is stored in a water storage unit 79 disposed at the auxiliary humidifier 65.

[0059] In addition, the auxiliary humidifier unit ~~65~~ includes a first ~~water~~ injector 81 disposed in the fuel gas supply line 27 to inject water into the fuel gas in the fuel gas supply line 27, and a second ~~water~~ injector 83 disposed in the oxidation gas supply line 29 to inject water into the oxidation gas in the oxidation gas supply line 29.

[0061] Water is supplied to each of the first and second ~~water~~ injectors 81 and 83. The first ~~water~~ injector 81 injects the supplied water into the fuel gas supply line 27, and the second ~~water~~ injector 83 injects the supplied water into the oxidation gas supply line 29.

[0062] The control unit 25 controls operation of the first and second ~~water~~ injectors 81 and 83. It is preferable that the first and second ~~water~~ injectors 81 and 83 are controlled to operate for a predetermined time (e.g., 10 seconds) after the operation of the fuel cell system 11. Because water is not sufficiently contained in the remaining oxidation gas and the remaining fuel gas in an initial stage of the operation of the fuel cell system 11, the supplied fuel gas and oxidation gas are humidified by the auxiliary humidifier unit including the auxiliary humidifier 65 in the initial state of operation of the fuel cell system 11.

[0065] The fuel cell system 11 according to the preferred embodiment of the present invention further comprises an electric ~~a~~ heater 85 that is disposed in the water storage unit 79. The electric heater 85 can be any arbitrary device for generating heat using electric power

provided from an external power source (e.g., a battery). When water stored in the water storage unit 79 is frozen, the electric heater 85 can melt it.

[0066] The control unit 25 controls operation of the electric heater 85. It is preferable that the control unit 25 controls the electric heater 85 to operate if the ambient temperature is lower than a predetermined temperature (e.g., 4℃). The ambient temperature can be detected by a temperature sensor (not shown).